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Total-reflection x-ray fluorescence apparatus and method using a doubly-curved optic

Abstract of the Disclosure

An improved total-reflection x-ray fluorescence (TXRF) apparatus using a doubly-curved optic is presented for use in detecting foreign matter on surfaces, for example, semiconductor wafers. The apparatus includes an x-ray source, a doubly-curved x-ray optic for diffracting and focusing the x-rays, a surface onto which at least some of the diffracted x-rays are directed, and an x-ray detector for detecting resultant x-ray fluorescence emitted by any foreign matter present on the surface. One or more apertures may be provided for limiting the dispersion angle of the x-rays. The crystal or multi-layer doubly-curved optic typically adheres to Bragg's law of x-ray diffraction may be curved to a toroidal, ellipsoidal, spherical, parabolic, hyperbolic, or other doubly-curved shape. An apparatus for diffracting x-rays is also presented. The apparatus includes an x-ray source and image defining an optic circle of radius R , an x-ray optic having a surface of radius R_p and a plurality of atomic planes which intersect the surface at an angle α , wherein the radius of the atomic planes R_p is defined by the equation $R_p = 2R \cos \alpha$. This diffracting apparatus may be used in a TXRF apparatus.